



Turning Liabilities into Assets in the Mining Sector

Market Opportunities for Flaring and Ventilation Air Methane Projects in the US

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Presentation Overview

- About Verdeo Group, Inc.
- Overview of US coal mine methane emissions
- Status of methane abatement project development in the US
- Impact of the emerging US carbon market
- Overview of technologies and project types
- Permitting and development challenges
- Conclusions

Who We Are



Founders experienced in global carbon markets...

Founders

- Founded by former executives from Climate Change Capital
- Experience developing projects around the world as part of \$1B carbon fund
- Offices in Washington, Austin and Denver

...with financial backing from leading institutional investors

Investors



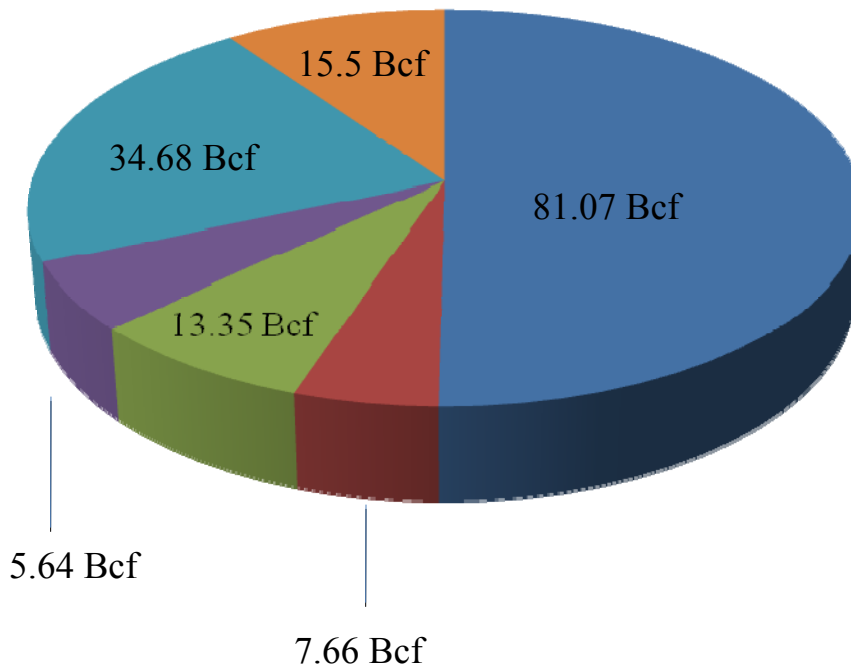
What We Do

Verdeo is a provider of leading project development and technology solutions that help US mining companies profit from emission reduction opportunities presented by the carbon market

Sources of US CMM Emissions

CMM represents 1% of total US GHG emissions and 10% of all methane emissions

2006 Sources of U.S. CMM Emissions (Bcf) and Viable Technology Applications



Ventilation Air Methane (underground)

- Oxidation

Underground De-Gas (Vented)

- Extraction

- Flaring

- Gas conditioning

- Power

Abandoned Mines (underground)

- Extraction

- Flaring

- Gas conditioning

- Power

Surface Mines

- Pre-mining degasification

Post-Mining (underground)

- Technologies TBD

Post-Mining (surface)

- Technologies TBD

Source: US EPA Emissions Inventory 1998-2006

Existing Project Development in the US

Blue Tip/Aberdeen Mine

Cryogenic plant converts abandoned coal mine methane into pipeline quality gas

DTE - Corinth

Cryogenic plant converts abandoned coal mine methane into pipeline quality gas

Consol

VP and Buchanan Mines; Pipeline, power, coal drying

Cambria

Abandoned coal mine, converts methane into pipeline quality gas using Molecular Gate technology

Consol

Windsor abandoned coal mine, RTO, VAM Abatement (MEGTEC)

JWR Blue Creek Mines

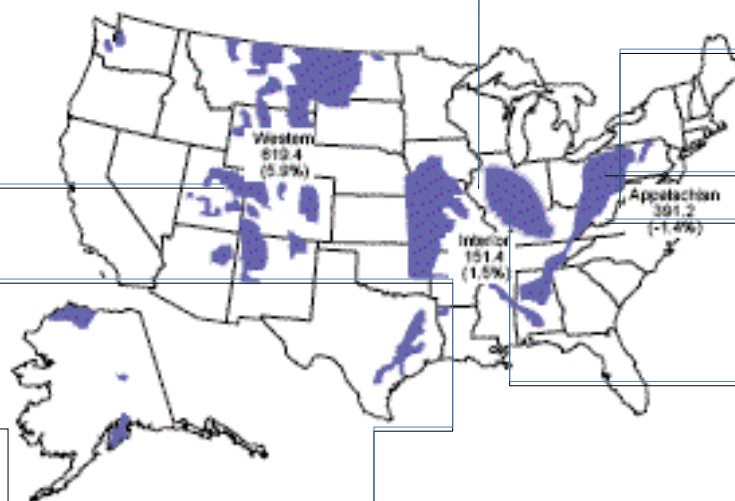
BCCK Cryogenic plant converts GOB gas to pipeline quality gas; 40,000 CFM, RTO, VAM abatement (Biothermica)

Shoal Creek and Oak Grove

Gas pipeline injection

Pinnacle Mine

Gas pipeline injection



Map Source: EIA: 2006 Coal Production by Coal Producing Region

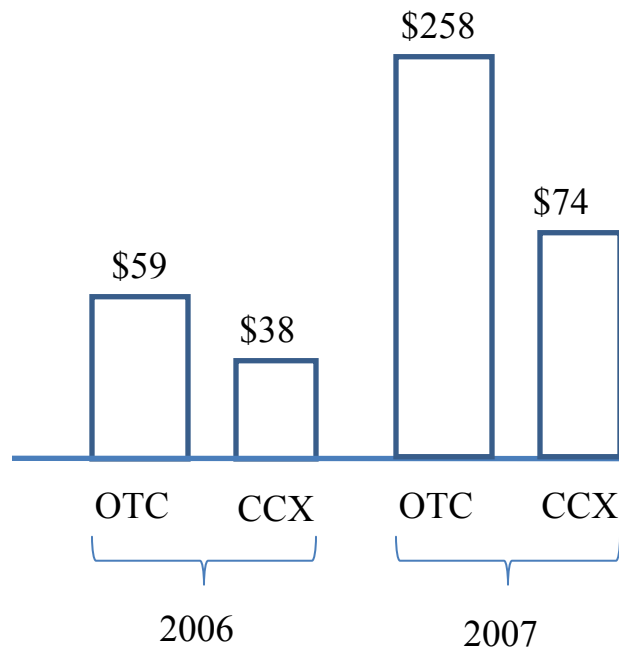
The US Carbon Market

Voluntary and emerging compliance markets serve as a catalyst for project development

Voluntary carbon markets are alive and trading...

...while the first US mandatory system begins in 2009

US Voluntary Systems
(Volume traded in \$MM)



US Mandatory Systems

Name	Geographic Region	Effective Date
Regional Greenhouse Gas Initiative (RGGI)	CN, DE, MA, ME, MD, NH, NJ, NY, RI, VT	Jan 2009
Western Climate Initiative (WCI)	AZ, CA, MT, NM, OR, UT, WA (US) and BC, MB, ON, QC (CAN), plus 13 observers (US, CAN, MEX)	TBD
Midwest Regional GHG Accord	IL, IA, KS, MI, MN, WI, MB (CAN)	TBD
California Climate Action Registry (CCAR)	CA	2011
Federal cap & trade system	US	2012 (est.)

Note: OTC = Over The Counter, CCX = Chicago Climate Exchange

Source: Ecosystem Marketplace, *State of the Voluntary Carbon Markets 2008*


Demand and Pricing

Three distinct market segments...

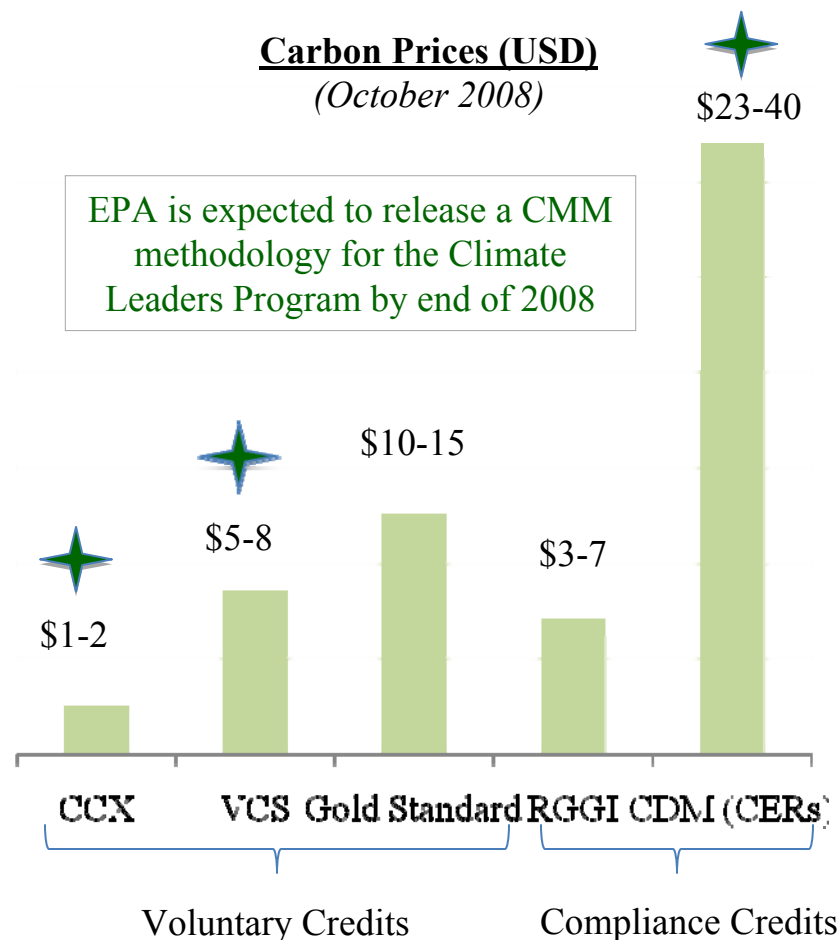
...with prices influenced by demand and quality

Customer Segments

Buyer	Examples	Criteria
Voluntary	Google, News Corp., Offset Retailers	“Charismatic” projects w/ multiple benefits
Pre-Compliance	Utilities, IPPs	Likelihood of regulatory eligibility, volume, credibility
Financial	Carbon/hedge funds; Commodity traders/banks	Price, option value, volume, low delivery risk

 *Indicates program has approved a CMM project methodology*

Carbon Prices (USD) (October 2008)



Carbon Market Mine Methane Opportunity

Coal mines can serve as a valuable source of carbon offset credits - today

- Coal mines will likely not be “capped” under future climate change legislation
 - Senate offsets amendment and Dingell-Boucher discussion draft identified CMM as a project type that should be eligible to generate carbon offset credits in a federal compliance market
- CMM is an approved project type under existing compliance and voluntary programs
 - Methodologies exist under Kyoto’s regulated Clean Development Mechanism (CDM) and the voluntary Chicago Climate Exchange (CCX)
 - EPA Climate Leaders is expected to release a CMM methodology by end of 2008
- Projects are considered highly “additional”
 - High quality credits command higher value (e.g., \$7-\$10/tonne vs. \$1-\$5/tonne)
- The market for voluntary and “pre-compliance” emission reductions is thriving
 - More companies are looking to purchase offsets as a way to reduce their carbon footprint for corporate responsibility purposes
 - Growing number of companies (e.g., utilities, large industrial emitters) that expect to be regulated under a future federal program are looking to lock in long-term purchases of credits *today* that they can use for compliance

Project Financing Options

The market for carbon expands options for financing projects

Financing & Development Option	Requirements	Pros/Cons
<ul style="list-style-type: none"> • Self-finance • Self-develop 	<ul style="list-style-type: none"> • Capital • In-house financial & technical expertise • Commitment 	<ul style="list-style-type: none"> • High upside • High risk • Control of schedule
<ul style="list-style-type: none"> • Third-party finance • Third-party develop 	<ul style="list-style-type: none"> • Ability to oversee outside investor and developer • Definitive contracts with clearly defined roles 	<ul style="list-style-type: none"> • Low risk • Low upside • Little control over project, schedule
<ul style="list-style-type: none"> • Co-invest with 1+ parties • Third-party develop 	<ul style="list-style-type: none"> • Capital • In-house financial expertise • Ability to oversee outside developer 	<ul style="list-style-type: none"> • Moderate risk • Moderate upside • Moderate control over schedule

De-gasification Methane Abatement

Destruction of methane gas through combustion in a enclosed stack flare

Extraction: Technology is standard and widely-deployed

Flare: Enclosed flare technology can be utilized to destroy methane emissions when pipeline fuel or power options are not feasible



Arch Coal (West Elk Mine)
3,000 CFM off-grid, methane
powered extraction pump



**UK Coal (e.g., Ricall Mine), 5 x
1,200 CFM, Enclosed Stack
“peaking” Flares**

Economics of a De-Gasification/Flare Project

Standard extraction and enclosed flare technology can be deployed to destroy methane and generate carbon credits when utilization is not feasible

Phase 1: Design & Permitting

Months 0-9

Phase 2: Creation of Carbon Credits

Years 1-10

Financial Returns (Illustrative)

Assumptions		Approximate Financial Returns	
Flow Rate	800 CFM @ 3 extraction points 643 MMCF per year	*IRR	34% - 41%
Methane purity	70%	*NPV (@15%)	\$2.0MM - \$3.2MM
CapEx	\$1.5MM		
OpEx + Annual CapEx	\$615K/year		
Carbon Price	Range between \$5-15/tCO ₂ e over 10-year period	<i>*Figures represent approximate returns on EBITDA.</i>	

Underground VAM Abatement

Technologies that destroy VAM are proven but utilization technologies remain to be widely-deployed

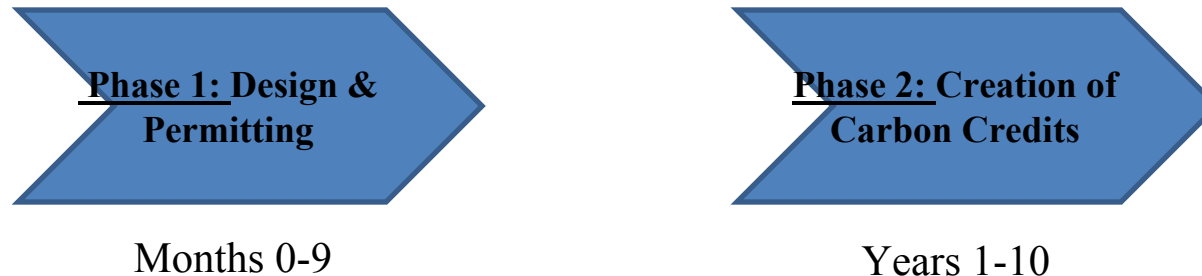
Oxidation: Regenerative thermal oxidizer can be used to destroy methane at low concentrations at high air flow rates. In addition, power generation may be commercially feasible.



BHP Billiton Illawarra Coal, West Cliff Colliery,
Australia, 150,000 CFM, 0.9% CH₄, 6 MW Power

Economics of a VAM Abatement Project

Destruction of VAM can generate significant reductions of GHG emissions



Financial Returns (Illustrative)

Assumptions		Approximate Financial Returns	
Flow Rate <i>(range accounts for CH₄ purity)</i>	300,000 CFM (3x100,000 CFM oxidizers) 709 MMCF combusted/year - 1,149 MMCF combusted/year	*IRR	16% - 41%
Methane purity	0.45% - 0.9%	*NPV (@15%)	\$275K - \$8.9MM
CapEx	\$5.7MM		
OpEx	\$650K/year		
Carbon Price	Range of \$8-15/tCO ₂ e over 10-year period	*Figures represent approximate returns on EBITDA.	

Gas Utilization Technologies

A range of technology applications exist that offer productive means of utilizing methane while also generating carbon credits from the destruction of greenhouse gas emissions

Gas Conditioning

Pipeline Fuel: New gas conditioning technologies allow for pipeline quality gas processing

Power: Gas can be combusted to generate power for on-site uses or sold to the grid

On-site Boiler: Gas can be used to power a boiler to generate useful on-site energy

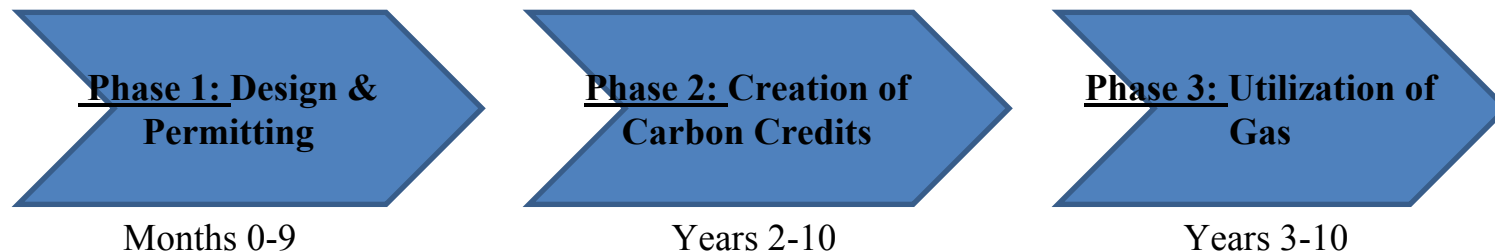
New Stranded Gas Technologies: New applications are being developed to convert natural gas to more easily transportable mediums, allowing for greater utilization



Cambria (PA) 1.7 MM SCF/Day, Molecular Gate gas conditioning technology

Economics of a Flare-to-Gas Utilization Project

One company's phased approach to project implementation...



...enabled it to maximize returns while funding new CapEx investments with revenue from carbon

Financial Returns (Illustrative)

Assumptions		Approximate Financial Returns	
Methane In-Flow Rate	3.5 MMCFD	*IRR	31% - 39%
Gas Sales	579 MMCF per year (Yrs 3-10)		
Methane purity	70%	*NPV (@15%)	\$5.4MM - \$8.6MM
Initial CapEx	\$6MM		
OpEx + Annual CapEx	\$1.6MM/year		
Carbon Price	\$8-15/tCO ₂ e over 10-year period	<i>*Figures represent approximate returns on EBITDA.</i>	
Gas Price	\$5.70 MCF - \$7.00 MCF in 2011		

Technology Deployment and Adoption Challenges

In light of the growing carbon market, why isn't more project development occurring?

- Ownership of gas rights is often unclear (but paramount for carbon projects)
 - Establishment of who owns gas rights may vary of a state-by-state basis; lack legal precedent
 - Western region mines face complicated federal-level Bureau of Land Management (BLM) gas ownership rights issues and conflicts with road-less regulations for wilderness areas
- Permitting for new application of technologies
 - MSHA very cautious in approving combustion technologies (flares, oxidizers) that mitigate methane emissions from operating gassy underground mines in the US
- Cost
 - For the lower quality mine methane (e.g., 30-70% CH₄ gob gas; <1.0% VAM) drainage, collection, processing and utilization systems require significant upfront capital and often deter/delay investment
- Carbon market uptake
 - Mining companies want to focus on core business; gas utilization and carbon are not yet priorities
 - Future climate change legislation is uncertain; voluntary and regional markets are fragmented

Navigating the Development Process

Entity	Areas of Jurisdiction	Challenges
Mine Safety and Health Administration (MSHA)	Mine safety and health; ensuring compliance with the Federal Mine Safety and Health Act (amended by the MINER Act).	Oxidizer requires approval of revised ventilation plan; Flare permitting remains uncertain.
US Bureau of Land Management (BLM)	Manages 700 million acres of subsurface mineral estate in the US.	Resolving/securing ownership is often problematic. Federally-owned CBM is developed under an oil & gas lease, not a coal lease. Difficulties on CMM may arise when gas is leased to an entity other than the entity with the coal lease.
US Forest Service (USFS)	Manages surface property on which subsurface coal assets may be owned by the BLM.	BLM is required to obtain approval and environmental recommendations from the USFS for USFS forestland before a competitive lease sale notice for gas rights is issued by the BLM – can be time intensive.
EPA	Implements/enforces laws and executive orders pertaining to water, air, climate, pollution.	Encourages use of technologies to reduce emissions, but has no authority over technology or project permits or approvals.
State environmental agencies	Enforces state laws pertaining to water, air, pollution; coordinates activities with federal, regional and local governments; owns land.	Policies and decision-making processes can vary across states.
State and inter-state oil and gas commissions	Issues permits to drill, operate and close oil and gas wells; ensures compliance.	Permitting approval process can overlap with requirements of other agencies.
Private land owners and mineral rights owners	Private ownership of surface lands and mineral rights.	Surface ownership may be different from lease or ownership of subsurface mineral rights; owner-protection laws vary by state.

Conclusions

Carbon is a valuable catalyst for helping coal mines to maximize value from methane assets

- **Deploy existing technologies** - Proven, existing technologies can be deployed to mitigate methane emissions and generate carbon offset credits
- **Generate new stream of revenue** - If properly designed, projects that reduce methane emissions can create a multi-year revenue stream from carbon credits and/or gas production
- **Reduce on-site energy expenses** - If properly conditioned, methane extracted by degas operations can offset power/natural gas purchases for onsite use.
- **Increase mineral production and improve mine safety** - Improved methane removal techniques increase mineral production rates and increase mine safety; revenue from carbon offset credits can be used to fund improvements in degas operations that also improve mine safety
- **Position to benefit from federal regulations** - Likely passage of Federal cap & trade legislation that recognizes CMM as an approved offset type is likely to significantly increase the value of carbon assets over time, helping to stimulate the market for new gas abatement and utilization technologies
- **Standards Matter** – Mine methane projects that pursue the highest quality standards available in the voluntary marketplace for their carbon credits demand a price premium and increase likelihood of acceptance for early action in a future compliance regime.

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